DEVELOPMENT OF ATTACHMENT FOR CUSTOMIZED STEERING RACK ON ONE SEATER DRAG BUGGY

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ABSTRACT

The title for this project is Development of Attachment for Customized Steering Rack on One Seater Drag Buggy. This project is under the UMP Mechanical Faculty. The main target for this project to the final year project student is to design, fabricate and analysis the customized mechanical part at the steering system of this buggy. This is to achieve the objective which is the steering system for the buggy is function without any problem. The steering system is very important to a vehicle to control and to navigate the vehicle movement direction. The system used mechanical principle to transfer the rotation from the steering wheel to the wheel through the steer rack that consist mechanical part such as pinion gear, bar gear and shaft. The analysis of the part is very important to gain the information on the maximum stress, minimum stress, load, FOS and the application of each material used to withstand the load. This buggy is design to roll at extreme terrain such as off-road and mud. The fabrication of the customized part and attachment of the part must be done properly to withstand the environment used of this vehicle. The other important aspect during fabrication and attachment process is the driver safety, this aspect is the priority during the development of the system.

ABSTRAK

Projek Tahun Akhir ini bertajuk Development of Attachment for Customized Steering Rack on One Seater Drag Buggy. Projek ini merupakan satu teras bagi pelajar tahun akhir bagi Fakulti Kejuruteraan Mekanikal UMP. Tujuan utama projek tahun akhir ini dijalankan adalah untuk melatih pelajar supaya berkeupayaan untuk mereka, mencipta dan menganalisis bahagian-bahagian yang direka supaya mencapai matlamat projek tahun akhir ini iaitu keupayaan megawal kenderaan ini tanpa masalah. Sistem kawalan kenderaan ini merupakan satu sistem yang penting dan utama dalam sesebuah kenderaan kerana ia akan menentukan arah pergerakan kenderaan dan mengawalnya. Sistem ini yang beroperasi secara mekanikal untuk memindahkan arah putaran pegemudi ke roda melalui rack kemudi yang mengandungi bahagian-bahagian mekanikal seperti gear pinion, gear bar dan juga shaft. Tujuan menganalisis bahagian-bahagian yang direka adalah penting kerana untuk memperoleh maklumat tambahan seperti maximun stress, minimun stress dan juga FOS untuk setiap bahagian yang terlibat dalam operasi pengemudian ini. Kenderaa buggy ini direka untuk pemanduan di luar jalan raya dan akan menerima tekanan yang tinggi di bahagian pengemudi. Setiap bahagian perlu mampu menampung tekanan akibat dari hentakan dan gegaran ketika memandu di kawasan tanah dan berlopak. Selain dari ketahanan, keselamatan pemandu juga penting dan keutamaan ketika proses reka cipta di jalankan.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

This project was purpose to make an off-road buggy for FELDA usage. It is design for off-road exploration through estate and can withstand extreme terrain. This buggy will be proposed for FELDA from UMP-MECHANICAL FACULTY after the fabrication, modification and basic analysis completed. This project was divided into three major parts for PTA students to handle under En. Mohd Fazli Bin Ismail (supervisor). Overall this project required the skills of designing, knowledge of the system and analysis of each component or part in the system.

1.2 Problem Statement

This Project will need modification and fabrication of extra part for the buggy's steering system. This is because on early development of this project the steering system had a rotation problem on the steer rack. The rotation motion of the rack is inverted with the front wheel steer direction. The main focus is to design and fabricate a gear box that will convert the rotation motion before it transfer to the steer rack. Others are to modified aftermarket steer system to perfectly fit when attaching the system with the buggy main chassis.

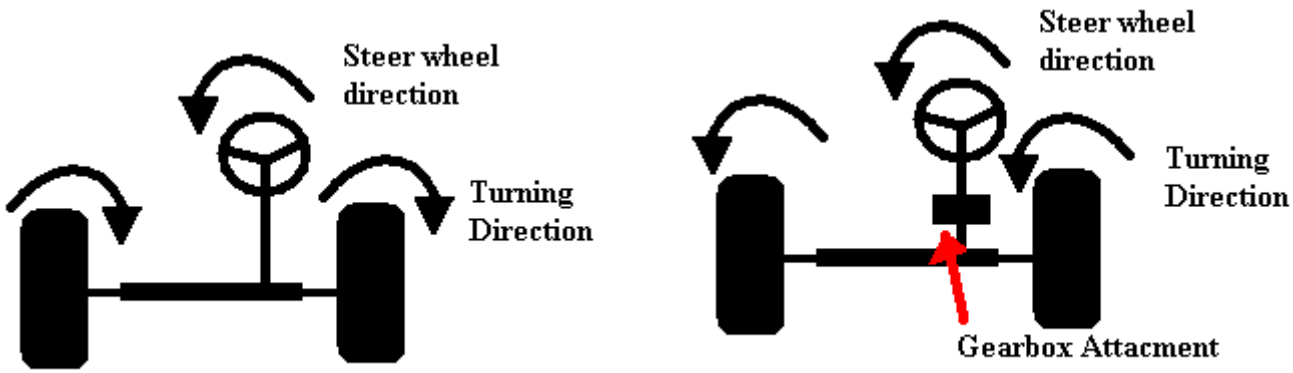


Figure 1.1

Problem statement and gearbox attachment to solve the problem

1.3 Project Objective

The objective of this project is to design, fabricate and modified the steering system on the buggy. By using the mechanical steer system, installation of additional custom part is required to convert the rotation of the steering wheel before it transfer to the steering rack.

- Modified – universal joint, alignment rod and steering rack.
- Fabricate – gear box.

1.4 Project Scope

Project Scope is the required step to gain knowledge and understanding on the main focus on the project.

The project scopes are:-

a) Investigation of the problem.

In this process, the main idea is to find the problems that occur on the steering system. Identifying latent or hidden problems on the buggy's steer system and then list down the possibility solution for solving the problem.

b) Set target specifications

Base on steering types and benchmarks (Benchmarking is information on competing products gathered to support the positioning). Develop metrics for each types of steering to help identify the specification of the system. Set ideal and acceptable values for each steer system.

c) Conceptualization.

Concentrate on designing the assembly line and create custom part for the steer system by making simple sketches known as thumbnail sketches of each concept. This is the brainstorming on the designing of costume made part that will fulfill the required specification needed for the part.

d) Further refinement and final concept selection.

Draw in 2D or 3D for part studies and for testing to the proposed product features and functionality (solid work).The Drawing will be analyze by using COSMOS Xpress to get the required information such as maximum stress, minimum stress and the factor of safety of each part.

e) Control drawing

In this stage, the main focus is to gain information on document functionally, features, size, surface finish and key dimension on each part. This information is helping in fabricate the final design models for the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Steer System

Steering system in automobiles are build from several component such as steering wheel, gears, linkages, and other components used to control the direction of a vehicle's motion. Because of friction between the front tires and the road, especially in parking, effort is required to turn the steering wheel. To lessen the effort required, the wheel is connected through a system of gears to components that position the front tires. The gears give the driver a mechanical advantage. Various types of gear assemblies, none with any decisive advantages over the others, are used, although some manufacturers prefer a rack-and-pinion system. In faster, heavier cars the amount of force required to turn the tires can be very great. Many of these cars use a power-steering system. The system contains a hydraulic booster, which operates when the engine is running and supplies most of the necessary force when the driver turns the wheel.

Figure 2.1 Mechanical Steer Systems

2.2 Type of Steer System Used In This Project

2.2.1 Rack-and-pinion Steering

Rack-and-pinion steering is quickly becoming the most common type of steering on cars, small trucks and SUVs. It is actually a pretty simple mechanism. A rack-and-pinion gear set is enclosed in a metal tube, with each end of the rack protruding from the tube. A rod, called a tie rod, connects to each end of the rack.

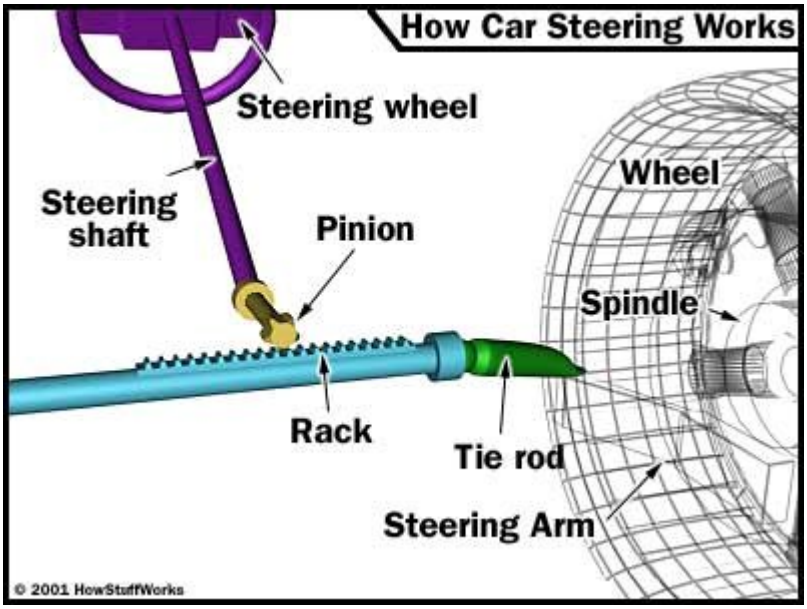


Figure 2.2 Mechanical Steer Rack inside View

The pinion gear is attached to the steering shaft. When you turn the steering wheel, the gear spins, moving the rack. The tie rod at each end of the rack connects to the steering arm on the spindle **(**see diagram above).

The rack-and-pinion gear set does two things:

- It converts the rotational motion of the steering wheel into the linear motion needed to turn the wheels.
- It provides a gear reduction, making it easier to turn the wheels.

2.2.2 Power Rack-and-pinion

When the rack-and-pinion is in a power-steering system, the rack has a slightly different design.

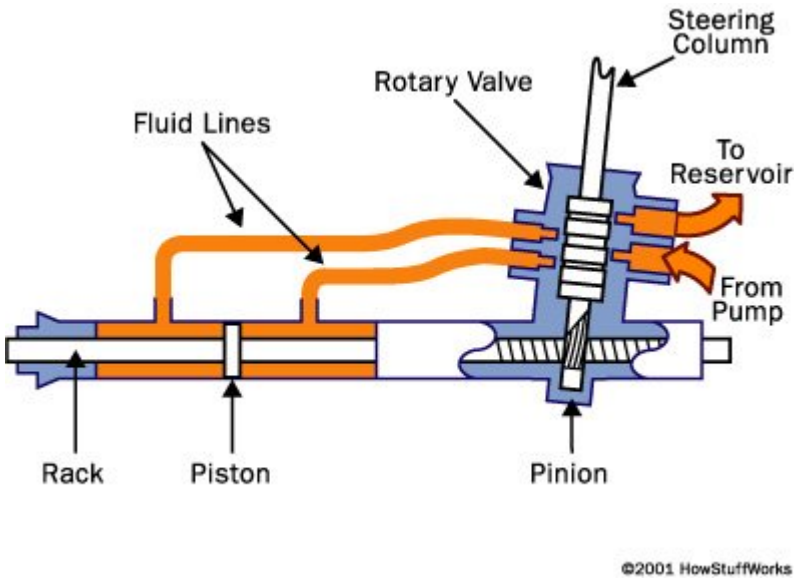


Figure 2.3 Power Steering System

Part of the rack contains a cylinder with a piston in the middle. The piston is connected to the rack. There are two fluid ports, one on either side of the piston. Supplying higher-pressure fluid to one side of the piston forces the piston to move, which in turn moves the rack, providing the power assist.

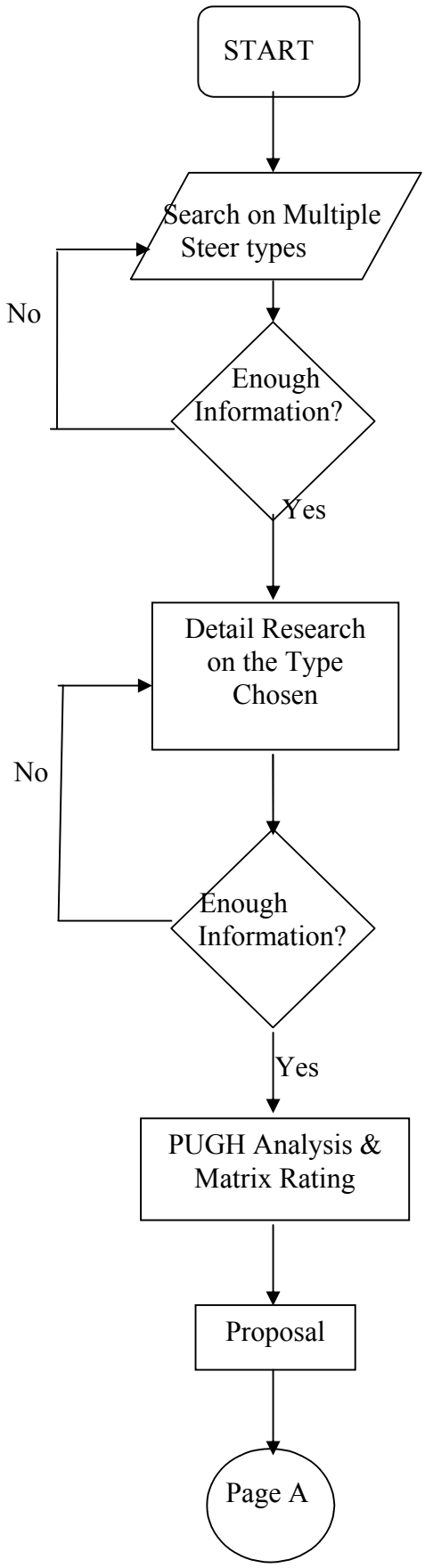
CHAPTER 3

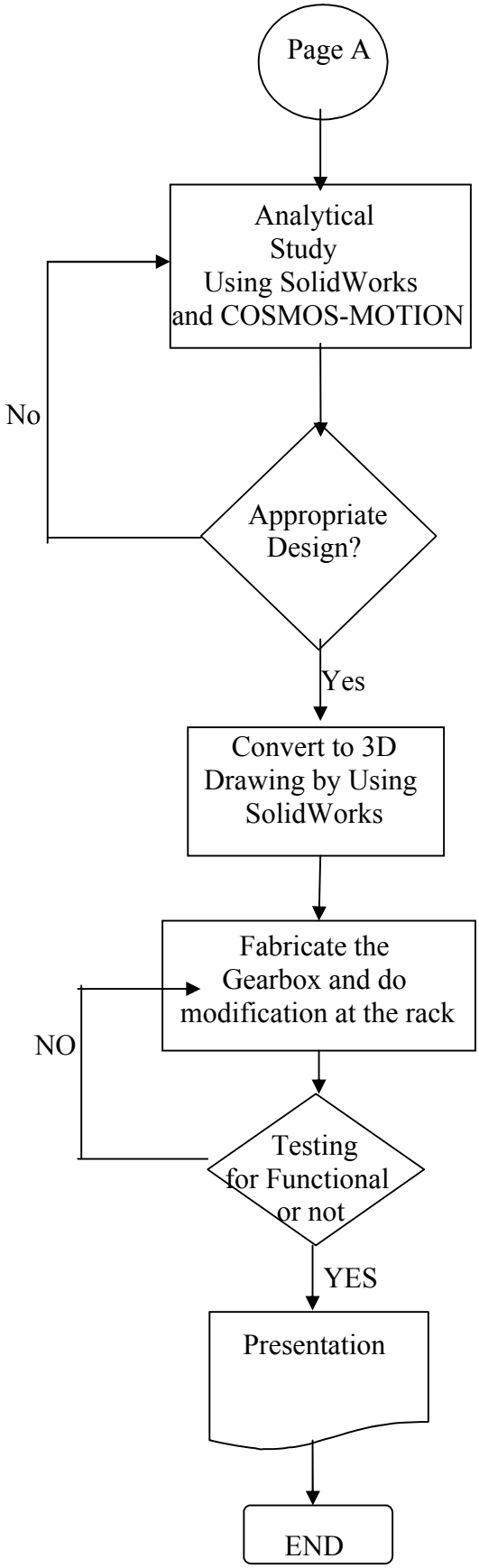
PROJECT METHODOLOGY

3.1 Project Flow

Methodology is the method that been used from early project develop until the end product release. It consist several stage of conducting this whole project. This flow will explain detail about each step of **Industrial Design Method** in developing new product that will achieve the required specification. To make sure this project complete on schedule, flow chart is important to assure all the planning running smoothly. The processes start with doing researches on the types of steer systems to gain more knowledge about the principle of the steer rack. The next step is doing metric and pugh analysis to select the best type of steering rack and propose to the supervisor before starting the next steps of the process. Brainstorming to get various concepts and do analysis of each concept to determine the best concept for the fabrication process. The concept will be converted to the 3D drawing for further studies on the dimension and the logical movement. The testing of the product will be done after the fabrications are finish. The last step is to compile all the information for presentation and report submission.

a) Flow Chart


START
Search on Multiple Steer types
No
Enough Information?
Yes
Detail Research on the Type Chosen
No
Enough Information?
Yes
PUGH Analysis & Matrix Rating
Proposal
Page A


Page A
Analytical Study Using SolidWorks and COSMOS-MOTION
No
Appropriate Design?
Yes
Convert to 3D Drawing by Using SolidWorks
Fabricate the Gearbox and do modification at the rack
NO
Testing for Functional or not
YES
Presentation
END

3.1.1 Problem and Part Studies

This is the first step of the flow. This is to identify the problems in the system and list down the causes of the problems. It also includes the studies of each part in the steering system to gain more knowledge and understanding on the principal of each component.

3.1.2 Designing Concept and Selection of Best Concept

This stage will need a lot of new concept develop in sketches to help in development of the best concept. This is because the concepts that have been develop from sketches are being compared in several aspects such as size, strength, material and ergonomic.

3.1.2.1 Concepts

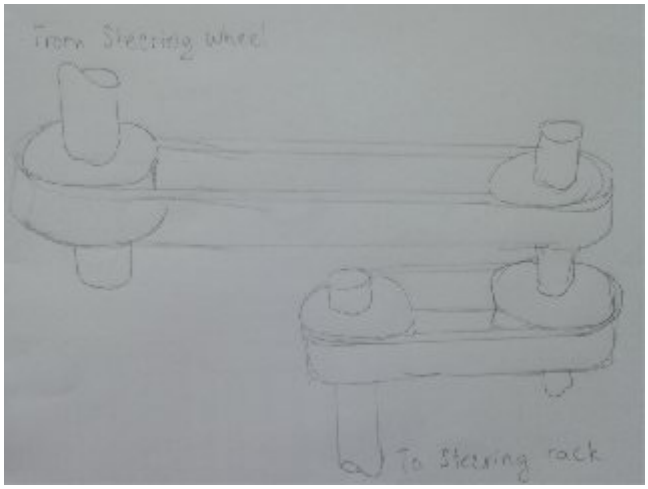


Figure 3.1:
CONCEPT 1 - Rotation transfer by belting concept

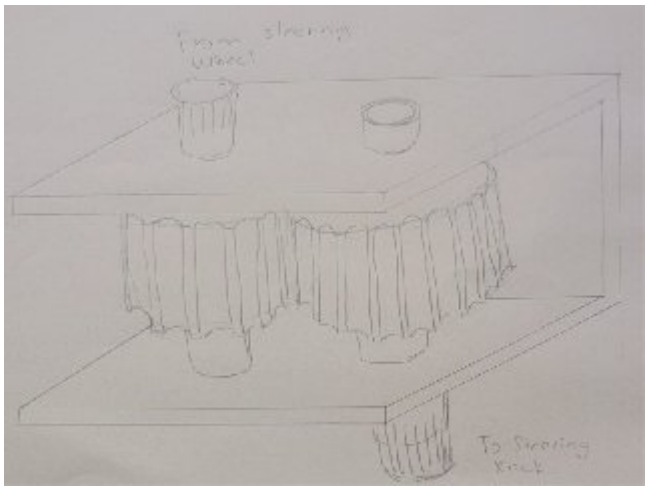


Figure 3.2:

CONCEPT 2 - Twin gear rotation concept

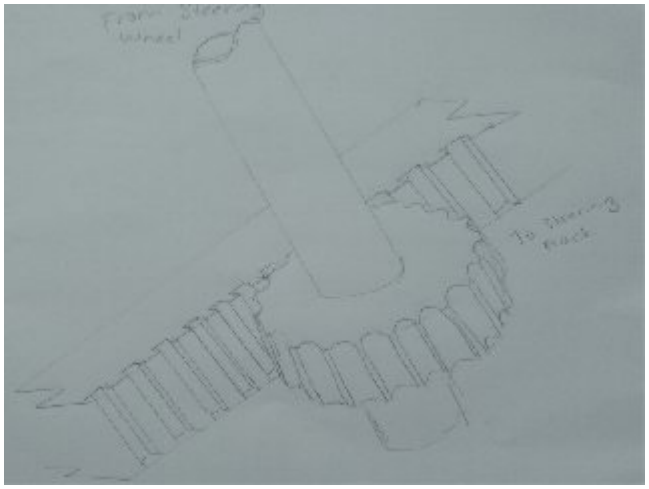


Figure 3.3:

CONCEPT 3 - Direct gear connection concept

3.1.2.2 Best Concept Selection

Basic Concept Analysis is done on each concept to compare the characteristic of each concept.

Table 3.1:- Concepts Comparison

Design	Advantages	Disadvantages
No.1	Low production cost. Easy installation and maintenance	No ergonomic value.
No.2	Small size High force	High production cost
No.3	Small size Low cost	Failed at high force